MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

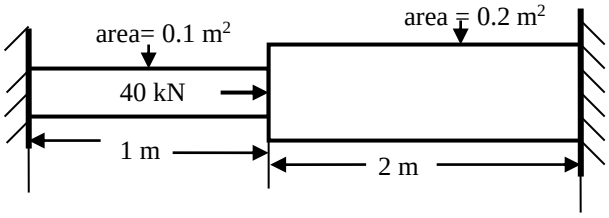
VII SEMESTER BTECH (CIVIL ENGINEERING)

END SEMESTER EXAMINATION, NOV 2022

FUNDAMENTALS OF FINITE ELEMENT METHOD (CIE 4082)

17 -11-2022 Time: 3 hrs Max. Marks: **50**

Note: 1. Answer **all** the questions.
2. Any missing data may be suitable assumed.

Q. No	Questions	MARKS	COS
1A	Illustrate the various types of elements used for finite element analysis	**3**	**CO1**
1B	What is displacement model ?. Write the displacement model for i) two noded bar element ii) two noded beam element iii) three noded triangular element iv) four noded quadrilateral element	**3**	**CO1**
1C	Illustrate the procedure to obtain the shape functions N1 and N2 for two noded bar element using Lagrange interpolation functions	**4**	**CO1**
2A	Evaluate the displacement at nodes for axially loaded bar shown in figure **Fig Q 1**. Take modulus of elasticity as $2x10^7$ kN/m^2.  **Fig 1**	**5**	**CO3**
2B	Evaluate the matrix C for plane stress condition.Take modulus of elasticity E= $2x10^7$ kN/m^2 and Poissons ratio $\mu = 0.3$	**2**	**CO3**
2C	Illustrate the procedure to obtain stiffness matrix K for two noded plane truss element	**3**	**CO2**
3A	Illustrate the procedure to obtain transformation matrix, T, for two noded space truss element	**3**	**CO2**
3B	A beam element of length 4 m is subjected to i) uniformly distributed load of intensity 10 kN/m and ii) point load of 20 kN at 2 m from node 1. Evaluate the equivalent nodal load vectors Q1, Q2, Q3 and Q4 due to these loads	**3**	**CO3**
3C	Forces in global direction for two noded plane frame element are as follows Fx1=20 kN Fy1=-30 kN M1= 50 kNm Fx2= -30 kN Fy2= 30 kN M2= -20 kNm. If the coordinates at node 1 is (0,0) and node 2 is (2,2), evaluate the forces in local directions	**4**	**CO3**
4A	Illustrate the procedure to obtain shape functions N1, N2 and N3 for three noded triangular element	**3**	**CO1**

4B	The coordinates at nodes for three noded triangular element are (0,0) at node 1, (2,0) at node 2 and (0,2) at node 3. Evaluate the matrix B for the element	**3**	**CO3**
4C	Illustrate the procedure to obtain natural coordinates (r and s) for four noded quadrilateral element	**4**	**CO2**
5A	Illustrate the procedure to obtain matrix B for four noded quadrilateral element	**3**	**CO2**
5B	Evaluate the displacement due to 300 kN load for axially loaded bar of length 3 m and c/s area 0.3 m^2 fixed at one end. The constitutive relationship defining the variation of E with displacement q is $E = 2x10^7(1-900q)^2$. Apply the load in three increments	**4**	**CO4**
5C	Illustrate the procedure to obtain the flow matrix (H) for two noded fluid element	**3**	**CO2**